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PLANNING GUIDE LINES

FOR

ECTN/WCTN TELECOMMUNICATIONS

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Planning Guidelines for ECTN/WCTN Telecommunications

Introduction

This paper presents a brief account of the features and capabilities of the hardware components to be used in the ECTN and WCTN communication systems. A brief outline is also given of the software now being developed to perform digital multiplexing of several data streams on to one communication link.

In implementing the networks, two communications media are available, UHF radio, or dedicated phone-line. The most cost-effective communications scheme will likely involve some combination of both media.

Planning Guidelines for ECTN/WCTN Telecommunications

1.0 Brief description of the hardware

1.1 Mk. 2 Outstations

Each outstation generates 60 samples per second. Each sample consists of two 10-bit bytes. Hence the data rate is 1200 bps. The byte structure is as follows,

hi byte;	bit 10	stop bit; always 1	
	9	code bit	
	8	E1	exponent bits
	7	Eo	
	6	P	sign bit
	5	M10	mantissa bits
	4	M9	
	3	M8	
	2	M7	
	1	start bit; always Ø	

lo byte;	bit 1Ø	stop bit; always 1	
	9	code bit	
	8	M6	
	7	M5	
	6	M4	mantissa bits
	5	M3	
	4	M2	
	3	M1	
	2	MØ	
	1	start bit; always Ø	

A two-byte seismic sample is transmitted lo byte first, then hi byte. In each byte the low order bits are transmitted first. Thus transmission occurs from bottom to top in the bit-list above.

A set of eight switches on the card cage back plane is used to generate an identification code for each station. Pending further deliberations, we have decided that all WCTN stations will be installed with identification codes beginning with the hex number Ø1 and progressing upwards. The ECTN stations will be installed with codes beginning at the hex number

FE and progressing downwards. Now since east is east and west is west, never the twain shall meet. At least not for a long time!

On command by the software the station can transmit its identification byte in place of seismic data. Similarly, the station can measure and send its power supply input voltage. Also on software command, the station can issue a current pulse to its seismometer, thus effecting a primitive calibration. The present software performs a calibration once every 24 hours. At the beginning of the cal. pulse the station identification byte is sent in place of the seismic data while at the end of the pulse the PSU input voltage is sent.

1.2 The Radios

The radios can transmit data at rates up to 4800 baud. A simple adjustment, either by a three-position slide switch or by wire jumpers configures the receiver for the desired baud-rate. Modulation is base-band so no modem is necessary with these radios.

1.3 Dual UART Module

This module is intended for those circumstances where multiplexing of data streams is advantageous. Each module has two type 1802 UARTS. Wire jumpers define baud-rates, word lengths, and other transmission parameters. It should be noted that each UART is independently configurable, and that receive and transmit baud-rates need not be the same. This is different from the UART contained on the CPU board, which must receive and transmit at the same baud-rate.

The outstation card cages have been wired to accept two of these DUMS.

1.4 Low-speed Modems

We now have 31 Intertel #2026 modems in service. Plans are underway to develop our own version of these, compatible in every way except having only the transmit capability. When these become available we will replace the Intertels now used for transmitting and use the Intertels for receiving only.

Since these modems are only capable of 1200 baud operation (1800 baud maximum) their use is limited to single station, non-multiplexed data links.

1.5 High-speed modems

Gandalf Communications Ltd. manufacture a modem which can transmit 9600 bits/sec over unconditioned, voice-grade phone-lines. This modem, called super modem #SM9600 is available with a multiplexer option which enables it to accommodate any combination of 4 channels at 2400 bps; 2 channels at 4800 bps, or 1 channel at 9600 bps. The instrument appears to be the ideal counterpart of our radio equipment.

It should be noted that while the outstation data is in asynchronous format and the super modem is intended for synchronous data, there is no significant difficulty in achieving compatibility. All that is required is for the transmitting UART to supply a clock, synchronous with the data, at RS-232 levels, and phased so that the trailing edge falls mid-way through the data bits. This clock can be derived with only a component or two added to the backplane wiring of the outstation card cage.

2.0 Brief description of the multiplex software.

The software is still under development but the essential features can be desribed. It is intended that a universal software package be developed which will be useful for data links implemented with either radios or telecom lines. In deference to the radio-links the software is limited to performing concentration of up to four stations onto one data link. It should be noted that the preferred term for multiplexing in the digital domain is "message switched concentration"; MSC for short.

Since communication over the links is one-way only, it is not possible to synchronize the sampling times at the outstations. Also any scheme of data concentration will involve various delays; some fixed, some variable. Thus the software must include some means of time-keeping to minimize timing uncertainties.

In order to minimize the need for new software at the central processor sites (Ottawa and PGC) the approach to the task of data concentration will be much the same as that used in treating the Borehole seismometer installation at Glen Almond, P.Q. At each transmission point data will be sent in packets where each packet will contain just one sample (2 bytes) of data from each station contributing to that data stream. Samples from each station will be sent always in a predetermined order. The configuration of the code bits, one bit per byte, will be used to define the various parameters of the packets.

2.1 Data Classification

As mentioned in section 1 above the outstation sends three kinds of data,vis seismic, station identification, and PSU voltage. Again as mentioned above, additional information for time-keeping purposes must accompany data undergoing concentration. To reduce the number of possible types of data which the central processor must identify and deal with, it is proposed that the data be classified in two steps. Thus the code bits will identify the data as being either seismic or auxillary data. The auxillary data will be further classified into the three categories mentioned above,vis station Id, PSU voltage, and

chronometrics. Identification of these and other possible categories will be made by using peculiar bit configurations within the data field. Additionally, the packet boundaries must be identified by the code bits.

To serve these purposes the following code-bit strucutre is envisaged.

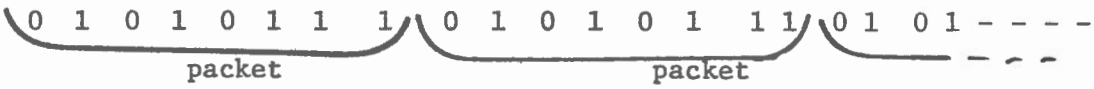
(i) for a simple outstation, non-concentrated, the code bits will be defined as follows:

lo	hi	
0	1	normal seismic data
0	0	auxillary data of all kinds

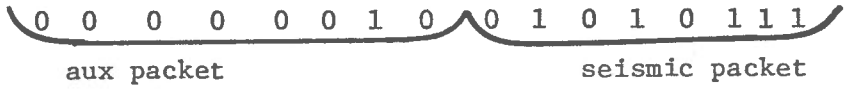
(ii) for a concentrated packet all code-bits will be as in (i) except for the last two bytes in a packet which will be defined as follows:

lo	hi	
1	1	seismic data
1	0	auxillary data

In this way, the low byte code bits are invarient within a packet and the high byte code bits indicate seismic or auxillary data. Furthermore the packet boundaries are indicated by dual one bits at the end of a packet. An eight byte packet, representing a four-station subnet will therefore send normal seismic data with the code bits configured as follows;



At each concentration point, non-seismic byte-pairs will be received and stored until a packet consisting entirely of auxillary data can be sent. The code bit structure for such a packet will be for a 4 - station subnet,



In this way the central processor can classify incoming data into either seismic data or auxillary data with only two possible code-bit patterns to test for.

2.2 Auxillary Data

Further classification of auxillary data is accomplished by structuring the 14 data bits as follows:

hi byte, bit	6	set to 1 to further identify as auxillary data
	5	
	4	identify, in binary fashion, up to eight types of auxillary data
	3	
	2	
	1	9 - bit parameter representing the auxillary data
	0	
lo byte, bit	6	
	5	
	4	
	3	
	2	
	1	
	0	

2.3 Auxillary Data type codes

The three-bit field reserved to identify the various auxillary data types will be defined as follows.

7 chronometry
6 stn. Id.
5 PSU input voltage
4 }
3 }
2 } To be defined as need arises.
1 }
0 }

2.4 Time-keeping

A 9-bit field reserved for time-keeping will indicate the length of time that a completed packet has languished in the concentrator before being expedited to the next node point. The unit of measurement is the processor interrupt interval, 833 micro-seconds. Time is calculated from the interrupt in which the last byte of the packet was received until that packet has become part of the output packet. At each node point this information is augmented by the further delay encountered at this node.

This procedure takes into account the variable delays but ignores the fixed ones. The fixed delays can be pre-calculated and corrected for by the central processor.

3.0 The ECTN Telecom Subnet

The following stations are to be linked to Ottawa by telecom lines,

(i) Salmon River, N.S.
(ii) Sackville N.B.
(iii) St. John N.B.
(iv) Frederickton N.B.
(v) Edmundston N.B.
(vi) Matane P.Q.
(vii) LaPocatiere P.Q.
(viii) Chicoutimi P.Q.

The first four stations will be linked to a node point at St. John, N.B. by means of 1200 baud modems as described in section 1.4. At this point a super modem operating at 4800 bps will send the composite data stream to a second node point located at LaPocatiere, and equipped with another super modem. Here the remaining four stations, each linked to LaPocatiere with 1200 baud modems, will be added to the data stream as a second channel, again transmitting at 4800 bps.

At Ottawa the two 4800 bps channels will be received by a third super modem and the two data streams fed to the LSI-front-end processor, each through one channel of a DZKII asynchronous line interface.

A similar telecom subnet may be worked out for WCTN to link the four stations, Eliza Dome, Estevan Point, Ucleulet and Port Alberni to PGC.